bered, has invited a diplomatic conference to be held in Washington upon this subject next year, addressed the meeting as follows: —

"Now that the important questions submitted to our deliberations have received, as I hope, their final solution, and that an agreement due to the merit of the cause has been reached, I ought, before the convention separates, to declare that the government and the learned societies of the United States are inspired in this matter, as almost all my eminent colleagues are aware, first, with the necessity of the change, and secondly, and more especially, with the desire of favoring the interests of science as well as those of commerce by land and sea.

"On the one hand, the civil day, as it now exists, has been preserved; on the other, for scientific and commercial reasons of high importance, a prime meridian and a zero of time, applicable to all nations, have been introduced. These decisions open a new era, which will be more and more appreciated, as the progress of nations, of international relations, and of science, — which knows no latitude nor longitude, — shall bring to light, in their assured development, all the advantages of the new system.

"About ten days ago the great railway-companies of the United States and Canada, operating 161,000 kilometres of lines, adopted the Greenwich meridian as the origin of time. I consequently think that I may express the hope that all the governments represented at the seventh conference of the Geodetic association will accept, on the recommendation of this conference, the invitation of the United States to send delegates to the international congress which is to be held next year at Washington, with the effect of resolving the question of the unification of longitudes and of time, and probably of proclaiming the great reform as an accomplished fact."

The mode of reckoning time proposed by the Geodetic association is substantially to use Greenwich mean solar time with the astronomical day. This is, perhaps, not absolutely inconsistent with the continuance of the system now in use in this country, of using Greenwich minutes and seconds with the most convenient hour, — a plan substantially the same as that first propounded by Professor Benjamin Peirce at the very beginning of the agitation for a new system. The geodetic congress assures us, that while there is nothing impractical in Greenwich time, pure and simple, the adoption of the time of the nearest whole hour from Greenwich is absolutely out of the question, because it would force people to get up and go to bed at unseemly or inconvenient hours. Indeed, their language would seem to imply that apparent as distinguished from mean time is imperatively required. "We do not, of course, wish," they say, "to suppress local time in common life, for that is necessarily and absolutely ruled by the *apparent* course of the sun: we do not dream of forcing the population of certain countries to rise at noon, nor of forcing others to dine at midnight." For people accustomed to regulate their actions by the striking of the church-clock, the change of time is certainly something more than a mere turning-round of the dial of the time-piece; and the European populations do go by the striking of bells much more than ours, no doubt. Nevertheless, the coming congress must be impressed by the eagerness with which our new system has been almost universally adopted, and even forced by the people upon the authorities. It is, perhaps, not surprising that it has been the scientific men, the theoretical men, who have been the last to judge the change to be practicable.

THE ORGANISMS OF THE AIR.

Les organismes vivants de l'atmosphère. Par M. P. MIGUEL, chef du service micrographique à l'observatoire de Montsouris. Paris, *Gauthier-Villars*, 1883. 8 + 310 p. 8°.

So much that has been written on the subject of the bacteria is merely a recapitulation of what has already been done, or a presentation of results based upon insufficient observations, that it is a pleasure to find a work filled with careful investigations carried out on an extensive scale.

The book before us contains no new or startling discoveries, but rather gives an almost mathematical proof of certain generally received ideas on the distribution of the microbia, and serves conclusively to refute certain errors which have been widely accepted.

The facts have been obtained by a daily analysis of the air taken in the Parc de Montsouris, near Paris. For the sake of comparison, air has also been taken from the centre of the city, the hospitals, and sewers.

After a brief historical sketch of the subject, comes a description of the organic and inorganic particles which have been deposited from the air, and which can be distinguished by aid of the microscope. Among the most interesting of the inorganic constituents are minute fragments of meteoric iron, which can be collected by passing a magnet over the dust, and of which Mr. Tissandier has made a special study. From the organic world are found vessels and bits of plants, as well as the cast-off shells of infusoria and their eggs, as proved by cultivation.

In order to study the particles suspended in the air itself, they must first be collected by aspirating a given quantity over a thin glass covered with glycerine, and then carefully examining the deposit. The cells thus obtained can be roughly divided, for purposes of classification, into four classes: —

1. Grains of starch.
2. Inert pollen of phanerogams, and the zoospores of unknown algae and cryptogams.
3. Spores of cryptogams and zoospores capable of producing a perfectly determinate alga, lichen, or other fungus.
4. Entire vegetables, usually unicellular plants, among which are to be noticed the green algae, the conidia, the yeasts, the *débris* of confervoids, diatoms, etc.

The starch comes mostly from the manufactures, but also from natural sources.

The pollen is never found germinating in the

air, however humid this may be. It is most abundant in spring and summer, and almost disappears during the autumn and winter. During the summer it exists to the number of from five thousand to ten thousand in every cubic metre of the atmosphere.

The spores of the cryptogams and algae appear during the damp months of April and May, and reach their greatest numbers in the latter part of June. They persist during the summer, and fall off during the autumn, to become as rare in winter as the pollen. The number varies from seven thousand in a cubic metre in December, to thirty-five thousand in summer. Fluctuations are found dependent upon damp or dry weather, the action of which, however, differs with the time of year. During a cold and wet period in winter, the spores sink to their minimum, while during the dry time the air is greatly enriched, but chiefly by old spores. In the summer, on the contrary, during damp days, the fructifications of the cryptogams are everywhere distributed in abundance.

"The average of the spores collected by the aeroscope is about fourteen thousand per cubic metre. These figures are not excessive, and it is to be hoped that they will settle the contradictory opinions in this regard which have been expressed during the past twenty years. They will go to confirm in their ideas the partisans of the germ-theory, and will show to the few defenders of spontaneous generation how useless it is to invoke the doctrine of heterogenesis to explain the appearance of the mucidines in the liquids and on the substances fitted to maintain their life."

From an etiological and hygienic point of view, it does not seem that such diverse spores, introduced into the economy at the rate of thirty thousand a day, or one hundred million a year, are absolutely innocuous. The development of soor in the mouths of infants and in the respiratory tract of the dying show that the fungi also belong to parasites ready to invade the human organism when there is presented a point of feeble resistance.

The analysis of the air taken from the sewers showed about the same amount of organized material, with the exception of the almost entire absence of starch.

The remainder of the book is devoted to a study of the bacteria present in the air. This is the part which will naturally be of the greatest interest, from the relations which these minute organisms bear to disease and to the processes of putrefaction and fermentation.

Chapter iii. is devoted to a statement of the experiments of Pasteur and others, proving conclusively the existence of germs in the air, which alone are responsible for changes in the liquids into which they fall, and thus setting at rest the question of 'spontaneous generation.'

The classification of the bacteria receives a valuable contribution as the result of long and carefully conducted experiments. The author is convinced of the immutability of the species, but shows that they are capable of great variations under different conditions, and that without great watchfulness 'species' can be easily multiplied. The genera which are usually recognized, and which he accepts, are Micrococcus, Bacterium, Bacillus, Vibrio, and spiral Microbia. Even these genera cannot always be distinguished apart with certainty by their form alone. The characters which serve to differentiate them are briefly as follows: Micrococci and Bacteria never produce spores, Bacilli do; Micrococci are immovable, Bacteria are movable; Vibrios and Spirilla have an undulated or twisted form.

The methods of obtaining the spores from the air, and the sterilization and preparation of the liquids proper for their development, are the subject of the next chapter. This, as all other parts of the work, shows the results of infinite care and patience. National prejudice is, perhaps, the reason why the solidified meat-extracts and blood-serum have not been employed for the cultivation of the spores. But it is perhaps fortunate for the progress of science that such prejudices exist, as each method is developed to its greatest extent, and the exact value of the one can be controlled by the other. The liquid nutritive material has certainly received a most thorough trial in the hands of Mr. Miguel, and the results obtained by its use are not to be thrown lightly to one side. There are infinite sources of error when experimenting with the 'infinitely small;' and the precautions which have been found necessary from these extended observations should caution those observers who have only limited means at their command against hasty generalization. One of the most important safeguards is the proper 'firing' of the flasks which are to receive the culture. Experience has shown that they should be heated during four hours at 200° C.; and then, after having been charged with the 'bouillon,' they should stand for two months at 35° C. in a constant temperature apparatus. At the end of that time those which have retained their limpidity are regarded as sterile, and ready to be sown.

In order to obtain the number of spores distributed in the atmosphere, equal amounts of air are drawn over these sterilized solutions, and are then allowed to germinate at a constant

temperature of 35° C. If five or six groups of experiments are made in the same day and place, the results are almost identical, provided that the force and direction of the wind are constant, and, above all, if the air has not been purified by rain or snow. From this, the equal distribution of spores is proved, and not that they are in so-called 'clouds,' as has been maintained by Tyndall.

Signs of germination may appear within twenty-four hours; but it is usually from the second to fourth day that the greatest number of flasks are altered. From this time there is a rapid decrease until the thirtieth day, after which any alteration rarely takes place. The growth is manifest to the unaided eye in three different ways: —

1°. The liquid preserves its clearness, but a more or less voluminous deposit occurs at the lower part.

2°. The liquid is uniformly clouded at first, and then a veil arises, or a deposit is formed.

3°. The liquid remains transparent, but little isolated white clouds of silky mycelium appear, which can invade the entire fluid. These are usually fungous growths, but there are several filamentous microbia which can give rise to the same appearance.

In the flasks which are altered by these aerian spores, there rarely is perceived that nauseating cadaveric odor of intense putrefaction, produced by inoculating a drop of water from a sewer or even from the Seine. The bacteria of the air are only feeble and superficial putrefactors, and rarely cause a profound decomposition of the liquids into which they are introduced. It is necessary to banish from the mind the idea that we live literally besieged by organisms always ready to sow putrefaction on the mucous tract of our economies. The inhabitants of the country, more privileged in this respect than the dwellers in the city, hardly introduce into their lungs, in the course of a day, one germ of putrid fermentation.

The degree of alterability of the nutritive liquid should always be taken into account in experiments; and numerous investigations were made on this point. From these it appeared that an infusion of hay was the least susceptible of alteration, while neutral beef-bouillon, with the addition of one per cent of salt, was the most so. Normal urine held a middle place. These had been sterilized by boiling for two hours at 110° C. Contrary to general expectation, egg-albumen, diluted with water and sterilized by filtration through plaster, was found to be almost as resistant as the infusion of hay.

In order to cultivate the bacteria in a state of purity, a drop of one cultivation is transferred to another sterilized flask on the point of a 'fired' platinum needle. The danger of infection from the air, during the time the flasks are opened to permit the transfer, is very much less than is generally supposed. By computation, the chances are only as 1 to 1,500.

The results of the daily examination of the air at Montsouris during three years showed that bacteria and their spores were more abundant during hot weather than cool, and were inversely proportional to the degree of moisture. The direction of the wind was also of consequence, that which had traversed Paris being richer than that coming from over the country.

In respect to the seasons, the greatest number of germs were found during the autumn, then followed summer and spring, and lastly came winter, as the following table shows: —

Autumn,	121	spores per cubic metre of air.
Summer,	92	" " " " " "
Spring,	73	" " " " " "
Winter,	53	" " " " " "
Or a mean of	84	" " " " " "

The germs which thus find their way into the air are either carried there when dry, or are taken up with fine particles of water by the wind: they never pass off with the insensible evaporation of a fluid. A series of ingenious experiments with the condensations from putrefying liquids and substances proved the truth of this assertion.

The comparative analysis of the air taken from the streets near the centre of Paris showed that it was nine or ten times richer in schizophytes than that from the Montsouris Park.

In regard to the relation of the bacteria in the air, and the occurrence of epidemics of disease, the fact was observed, that, at the time when there was a comparative increase of deaths from zymotic disease, there was an unusually large number of germs in the air. As it is impossible at present to distinguish harmless from pathogenic microbia, and as the inoculation of cultures from atmospheric spores gave nearly negative results, the author wisely does not lay great stress upon this coincidence.

The interiors of houses were next made the subject of investigation. It was found, that, in a room which was perfectly still and undisturbed, there were 27 microbia to the cubic metre, against 97 in the air outside. The number in the same space in the author's laboratory was found to be 215 in 1880, 348 in 1881, and 550 in 1882. In an ordinary bed-chamber

in Paris, regarded as sufficiently clean, there was found, in the spring of 1882, 3,830, and, in the winter of 1882, 6,500; giving a mean of 5,260 to the cubic metre. A comparison with the air of a room used for a study in the observatory at Montsouris showed, for the spring of 1882, 270, and, for the winter of 1882, 380; giving a mean of 325 to the cubic metre. From this it at once appears that the air of the house in Paris was sixteen times as impure as that at Montsouris. The decrease in the number of germs from winter to spring is the reverse of what is observed out of doors, and is to be attributed to the more thorough ventilation during the warm months.

The same relation was found in the air from hospitals, except that the numbers were very much higher; varying from 4,500 in summer, to 24,000 in winter, per cubic metre. The micrococci were found to be most abundant here; every hundred germs furnishing, on an average, ninety-one against five bacteria and four bacilli. The inoculation of these, however, was without result.

The air and water from the sewers gave interesting results. A cubic metre of the former furnished from 800 to 900 microbes, while a litre of water taken at the point where it was discharged gave 80,000,000. In this relation it was found that a litre of water condensed from the atmosphere held about 900, a litre of rain-water 64,000, a litre of the Seine at Bercy 4,800,000, while, after the river had traversed Paris, a litre was found to contain 12,800,000. From this it can be understood how easily stagnant water of a sewer can putrefy, and how essential it is that there should always be a current flowing to prevent this. In the air of sewers it is the bacteria proper which abound, but they were without effect when inoculated in animals.

In the ordinary dust of houses it was estimated, after careful weighing and cultivation, that each gram contains about 750,000 spores. A sufficient number of analyses of the soil have not been made as yet, but those made give an average of from 800,000 to 1,000,000 for each gram of earth. In the deeper layers the bacilli preponderate over all other forms, while on the surface the micrococci are most abundant.

Antiseptic substances are last considered; and these are regarded as acting in two ways, — first by destroying the bacteria already in activity, and, secondly, by preventing the germination of spores.

Of such substances, oxygenated water (H_2O_2) was found to be the most powerful, then solution of corrosive sublimate and nitrate of silver. After these come a long list of less efficacious ones. The only compounds which were capable of destroying germs in their dry state by means of the vapor given off were bromine, chlorine, hydrochloric and hyponitric acids.

Such is a brief summary of the principal points touched upon in this book. It is not quite so clearly and concisely written as might be wished; but it is a valuable contribution to science, and must serve as a model for any one who undertakes work in this direction. A careful perusal of the book itself is certainly to be recommended to all interested in the subject.

MINOR BOOK NOTICES.

Outlines of chemistry for agricultural colleges, public and private schools, and individual learners. By N. B. WEBSTER. New York, *Clark & Maynard*, 1883. (Practical science series.) 8+144 p. 24°.

THIS book seems somewhat out of place in a practical series, inasmuch as it consists chiefly of a collection of definitions and brief statements of common facts.

The experimental side of the subject is almost wholly neglected, or, at best, is passed over with brief allusions. To the student who is receiving instruction by lectures, the work might be of some service as a partial relief in taking notes, or as a book of reference, though it is too limited in detail to be of general use in this direction; but, as a text-book in a systematic course of instruction in elementary chemistry, it must fall short of the author's intention.

The electric light in our homes. By ROBERT HAMMOND. New York, *Worthington*, 1884. 12 + 188 p., illustr. 8°.

THIS is a special pleading for the incandescent electric light, delivered by Mr. Hammond in the towns of England as he travelled, in the hope of awakening the English people to the fearful condition of their homes at present, on account of the harmful effects of the products of gas consumption. In the opening, Mr. Hammond is very careful to first heat his audience over the gas-burners, then drench them with the condensed steam, and finally sprinkle them here and there with little specks of soot. After bringing his hearers into this unpleasant condition, a bright, clean, and cool incandescent electric light is held before their eyes till they fully appreciate its beauties. A short return is made to the drenching and warming process to make sure of any laggards, and the conditions of success of an electric-light system are explained. The story is well told